SUGAR CROPS RESEARCH

Progress Report

A summary of current program and preliminary report of progress of the United States Department of Agriculture and related work of the State Agricultural Experiment Stations.

This progress report is primarily a research tool for use of scientists and administrators in program coordination, development, and evaluation; and for use of advisory committees in program review and development of recommendations for future research programs.

The summaries of research progress include some tentative results that have not been tested sufficiently to justify general release. Such findings, when adequately confirmed, will be released promptly through established channels. Because of this, the report is not intended for publication and should not be referred to in literature citations. Copies are distributed only to members of Department staff, advisory committee members, and others having a special interest in the development of public agricultural research programs.

This report also includes a list of publications reporting results of U.S.D.A. and cooperative research issued during the past year. Current agricultural research findings are also published in the monthly U.S.D.A. publications, Agricultural Research and The Farm Index.

UNITED STATES DEPARTMENT OF AGRICULTURE
Washington, D. C. 20250

December 31, 1968

RESEARCH ADVISORY COMMITTEES

The following Research Advisory Committees were established pursuant to Title III of the Research and Marketing Act of 1946:

1. Farm Resources & Facilities
2. Utilization Research & Develop.
3. Human Nutrition & Consumer Use
4. Marketing
5. Agricultural Economics
6. Forestry
7. Animal & Animal Products
8. Cotton
9. Grain and Forage Crops
10. Horticultural Crops
11. Oilseed and Peanut Crops
12. Plant Science & Entomology
13. Sugar Crops
14. Tobacco

The source materials used by the advisory committees include organizational unit progress reports and subject matter progress reports. The latter contain information which was first reported in the organizational reports and has been assembled for use by commodity committees. The number prefixes shown below refer to advisory committees listed above.

ORGANIZATIONAL UNIT PROGRESS REPORTS

Agricultural Research Service (ARS)

1 - Agricultural Engineering
1 - Soil & Water Conservation
2 - Utilization -- Eastern
2 - Utilization -- Northern
2 - Utilization -- Southern
2 - Utilization -- Western
3 - Human Nutrition
3 - Consumer & Food Economics
4 - Market Quality
4 - Transportation & Facilities
7 - Animal Husbandry
7 - Animal Disease & Parasite
12 - Crops
12 - Entomology

Economic Research Service (ERS)

5 - Economic Development
4, 5 - Marketing Economics
5 - Farm Production Economics
5 - Economic & Statistical Analysis
5 - Foreign Development & Trade
5 - Foreign Regional Analysis
1, 5 - Natural Resource Economics

6 - Forest Service - Research (FS)

4, 5 - Farmer Cooperative Service (FCS)

4, 5 - Statistical Reporting Service (SRS)

SUBJECT MATTER PROGRESS REPORTS

6 - Forestry (other than Forest Service)
7 - Animal-Poultry and Products Research Other Than Husbandry, Disease and Parasite
8 - Cotton and Cottonseed
9 - Grain and Forage Crops
10 - Horticultural Crops
11 - Oilseed and Peanut Crops
13 - Sugar Crops
14 - Tobacco

A copy of any of the reports may be requested from Max Hinds, Executive Secretary, Sugar Crops Research Advisory Committee, Research Program Development and Evaluation Staff, U. S. Department of Agriculture, Washington, D. C. 20250

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INTRODUCTION

This report, which is prepared annually, deals with work directly related to the production, processing, distribution, and consumption of sugarcane, sugarbeets, and sweet sorghum. It does not include extensive cross commodity work, much of which is basic in character, which contributes to the solution of not only sugar problems but also to the problems of other commodities. Progress on cross commodity work is found in the organizational unit reports of the several divisions.

The report covers Farm Research; Nutrition, Consumer and Industrial Use Research; and Economic Research. As shown in the table of contents, there is a breakdown of the research program by problem areas.

For each subject matter area there is (1) a tabular presentation of the USDA and Cooperative program showing the number of scientist man-years and location of the work; (2) statement of problems and objectives; (3) summary of progress during the past year; and (4) a list of publications. In some of the tables reference will be made to Research Problem Areas (RPA's). The numerical designations are derived from "A National Program of Research for Agriculture, October 1966. The first digit refers to the national goal and the following digits to the problem area. In this report, the tables on page 1 and 34 contain information pertaining to four of the nine national goals set forth in the National Program of Research for Agriculture, namely: Goal II, Protection of Forests, Crops, and Livestock; Goal III, Efficient Production of Farm and Forest Products; Goal IV, Product Development and Quality; Goal VII, Consumer Health, Nutrition, and Well-Being. The following are the research problem areas:

307 - Improvement of biological efficiency of field crops.

208 - Control of diseases of field crops.

207 - Control of insect pests of field crops.

405 - Production of field crops with improved consumer acceptability

701 - Insure food products free from toxic residues from agricultural sources.

708 - Human nutritional well being.

703 - Food choices, habits, and consumption.

704 - Home and commercial preparation of food.

Research on sugar crops is supported by (1) Federal funds appropriated to the research agencies of the U. S. Department of Agriculture, (2) Federal and state funds appropriated to State Agricultural Experiment Stations, and (3) private funds allotted, largely by sugar industries, to research carried on in private laboratories or to support of State Station or USDA work.

Research by USDA

Farm Research in the Agricultural Research Service comprises investigation on introduction, breeding, and genetics, variety evaluation, culture, diseases, nematodes, weed control, insects, and crop harvesting and handling operations and equipment. It is carried out in the following divisions: Crops, Entomology, and Agricultural Engineering. The work involves 64 professional man-years of scientific effort.

Nutrition, Consumer and Industrial Use Research conducted in the Agricultural Research Service discussed in this report pertains to the chemical and physical properties, new and improved products, new and improved processing technology of sugar crops. The research was conducted by the following divisions: Southern Utilization Research and Development Division, Consumer and Food Economics, and the Human Nutrition Divisions. The work on sugarbeets at the Western Utilization Research and Development Division and on sugarcane at both the Northern and Southern Utilization Research and Development Divisions was terminated at the close of the 1965 fiscal year. The continuing research effort involves 2 professional man-years.

Economic Research pertains to the organization and performance of markets with respect to market institutions and market power; substitutes; prices, margins, and costs; and location and interregional competition. This work is conducted by the Marketing Economics Division of the Economic Research Service. Research in cooperative marketing is conducted by the Farmer Cooperative Service. The sugar research in these Services involves 2 professional man-years.

Interrelationships Among Department, State and Private Research

A large part of the Department's research is cooperative with State Experiment Stations. Many Department employees are located at State Stations and use laboratory and office space close to or furnished by the station. Cooperative work is jointly planned, frequently with the representatives of the producers or industry participating. The nature of cooperation varies with each study. It is developed so as to fully utilize the personnel and other resources of the cooperators, which frequently includes resources contributed by the interested producers or industry.

Research in industry and other organizations is sponsored primarily by beet and sugarcane companies, processors, sugar refiners, and chemical companies.

Beet sugar companies conduct applied research on breeding and genetics, nutrition, and agronomic practices, including production and processing of sugarbeet seed. The Department supplies new varieties and conducts the basic research needed by the beet sugar companies in their research program.

Large companies that grow sugarcane in Florida, Louisiana, Puerto Rico, and Hawaii conduct research on breeding, variety evaluation, cultural practices, fertilization, and the use of chemicals to expedite (1) the accumulation of sugar in sugarcane, and (2) harvesting operations. Information from such research is made available to Federal and State scientists who cooperate by conducting the basic research necessary to such activity.

Chemical companies conduct research for the development of more effective fungicides for the control of diseases which attack sugar crops and for side dressings. Also, some chemical companies are engaged in the formulation of chemicals for use as desiccants, as fungicides, as growth stimulants, and as retardants to hasten maturity of sugarcane. Federal and State groups provide the basic and fundamental phases essential to this area of research.

Basic research done by the Department and States will be utilized by industry and other organizations in their research programs, especially in the further development of improved products and equipment. Industry's cooperation in supporting sugar research at Federal and State Stations has contributed greatly to its success.

Example of Recent Research Accomplishment by USDA and Cooperating Scientists

Three Sugarbeet Hybrids Released. The first American varieties of sugarbeet that will provide protection against virus yellows have been released as US H9A and US H9B. These hybrids have increased acreable yields of sugar by 22 and 27 percent, respectively, under moderately severe disease exposure, and approximately 2 million pounds of seed have been produced to meet grower demands. US H20, a 3-way hybrid moderately resistant to Cercospora leaf spot and excellent in quality, has been released for use in the Great Lakes region.

I. FARM RESEARCH

SUGAR PLANT BREEDING AND GENETICS, DISEASES, QUALITY AND VARIETY EVALUATION, CULTURE, AND PHYSIOLOGY
Crops Research Division, ARS

USDA and Cooperative Program

Location of Intramural Work	Scientist Man-Years F.Y. 1968 Research Problem Area					Total
	307	208	207	405	701	
Sugarbeet						
Maryland (Beltsville)	2.0					2.0
Arizona		1.0				1.0
California	6.3	2.7				9.0
Colorado	2.1	0.3		0.3		2.7
Michigan	1.8	0.6		0.6		3.0
Minnesota		0.5		0.5		1.0
Utah	3.4	1.5		1.1		6.0
Total Sugarbeet	15.6	6.6		2.5		24.7
Sugarcane						
Maryland (Beltsville)	0.4		0.1		0.4	0.9
Florida	3.9	1.6			1.5	7.0
Georgia	0.4				0.3	0.7
Hawaii	0.4	0.4				0.8
Louisiana	2.8	1.6	0.3	0.7	1.6	7.0
Mississippi	0.9	1.3				2.2
Puerto Rico	0.3	0.7				1.0
Total Sugarcane	9.1	5.6	0.4	0.7	3.8	19.6
Sweet Sorghum						
Maryland (Beltsville)	0.2				0.2	0.4
Georgia	0.2				0.1	0.3
Mississippi	0.3	0.5				0.8
Total Sweet Sorghum	0.7	0.5			0.3	1.5
Total	25.4	12.7	0.4	3.2	4.1	45.8

Intramural program is supplemented by extramural support representing (a) 3.45 SMY's at State Agricultural Experiment Stations1/, (b) 2.25 SMY's at other U.S. Institutions2/, and (c) P.L. 480 funds in 3 countries representing 104,320 U.S. dollars equivalent.

1/ RPA 307 1.65; RPA 208 1.00; and RPA 405 0.80.

2/ RPA 307 1.0; RPA 208 0.25; and RPA 405 1.0.

Problems and Objectives

Approximately 6 million tons of sugar, together with byproducts, are produced annually by the domestic sugar industry and have a market value of about $1 billion. In order to maintain profits, improvement in efficiency of production and in quality should be commensurate with advancing costs. The acreable yield of sugar has not increased significantly during the past decade. Processors are experiencing difficulties in crystallization of sugar because of decrease in quality. Producers suffer severe losses caused by diseases, pests, and environmental stress. Solutions to these problems of sugar crops are feasible through programs of research.

The major objectives of the research are:

1. Improvement of quality and biological efficiency.
2. Protection against disease and pest damage.
3. Production practices that facilitate mechanization.
4. Reduction of decay and spoilage in field and in storage.

Progress - USDA and Cooperative Program

-- Sugarbeet --

RPA 307 - IMPROVEMENT OF BIOLOGICAL EFFICIENCY

A. Breeding and Genetics

1. US H20 released for Great Lakes region. Variety tests in the Great Lakes region show the superiority of the male-sterile monogerm F_1, SL(129 X 133), as seed parent in three-way commercial hybrids. Tests of 1964, 1965, and 1967 demonstrated that SP 6322-0 is a better pollinator than SP 5822-0, which has been used for several years. The excellent yield and quality of the three-way hybrid SL(129 X 133) X SP 6322-0 have been established for the Great Lakes region. This hybrid has been released as US H20.

2. Multiple disease resistance. Varieties of sugarbeet that are recommended for planting in the Rocky Mountain and the Pacific Coast regions must provide protection against damage caused by both curly top and Cercospora leaf spot. In the past, breeding programs provided varieties that carried resistance to one but not to both diseases. Regional field trials have demonstrated that a new hybrid, resistant to both curly top and leaf spot, exceeded the standard in acreable yield of roots and gross sugar by 21.3% and 22.9%, respectively.

3. Protection against the cyst nematode. All cultivars of *Beta vulgaris*, including sugarbeet, are susceptible to the cyst nematode; but the viny, fibrous-rooted species, such as *B. patellaris*, are immune to the pathogen.

Progress is being made in transferring to the sugarbeet the factors conditioning immunity in the wild beet. Hybridization of these species resulted in an F_1 that is usually not viable on its own roots. When made viable through grafting to sugarbeet, the F_1 hybrid plants are self sterile but are cross fertile if provided with sugarbeet pollen. Backcrossing to sugarbeet improves vigor but results in undesirable segregants that generally resemble the wild grandparent. However, resistant genotypes occurred in populations of the first and second backcross generations. These resistant plants have an extra chromosome which presumably carries the resistant factors and is derived from the wild beet. After several years of research, two plants possessing immunity to the nematode were found in populations of the third backcross. These plants also resemble the sugarbeet in that they have fleshy roots and the normal diploid complement of chromosomes.

4. Curly top immunity from wild beet. Many years of breeding sugarbeet for curly top resistance has established a level of tolerance that prevents catastrophic losses; but immunity which would provide full protection against the virus has not been achieved. The only source of immunity occurs in Beta corolliflora, a wild beet that is a perennial weed in the Middle East where both the curly top virus and the vector are indigenous. The wild beet and tetraploid sugarbeet were hybridized. Large backcross populations were inoculated by means of viruliferous leafhoppers. Symptomless plants received multiple inoculations to assure true immunity. The vector was unable to acquire the curly top virus from these plants, which indicates that they are not only symptomless but are also noncarriers of the virus. The majority of the immune segregants had from two to four extra chromosomes.

5. Genetics of chemical constituents. A phenolic compound, "3-hydroxytyramine", has a general relationship to Cercospora leaf spot resistance in the sugarbeet. Genetic principles conditioning the association of this compound with several salient chemical components of sugarbeet juice have been investigated. Divalent metallic ions as a class do not appear to be functionally related to 3-hydroxytyramine, but the relationship of this compound to calcium concentration is consistently negative and worthy of further study.

6. Inheritance and linkage of characters. Extensive tests for linkage among nine genetic factors in sugarbeet demonstrated that the a_1 gene, responsible for Mendelian male sterility, is independent of the others and represents a separate linkage group. Five of the potential nine linkage groups in the sugarbeet have been established from this study.

7. Heterosis. In an F_2 generation, transgressive segregation for increased size of beet indicates the presence of genes with additive effects which condition this character. These genes probably are not

unique to the inbred parents of the F_2 under study. Seven interpollinated transgressive segregants produced heavier roots than an interpollinated random sample of the F_2, but their combining ability did not differ from that of the random sample. This study indicates that individuals superior because of additive genes may have no better combining ability than a random sample from their parent population.

B. Physiology and Culture

1. Growth studies with sugarbeet. In the Rocky Mountain region, early planting resulted in an increase of 4.25 additional tons of beets per acre over late planting, with 0.8 percent more sucrose. Nitrogen fertilizer results in increased sugar yields in some soils; however, in highly fertile soils, applications of 125 pounds of N per acre may enhance foliage but actually reduce sugar yield. Late plantings resulted in low leaf area when solar radiation was at maximum, which in part explains the low yields of late plantings.

2. Aluminum toxic to the sugarbeet. The sugarbeet, a salt-tolerant plant, is sensitive to acid soils and generally fails to make normal growth at pH 5.5 or below. Acid soils, such as the Caribou and Conant series in Maine, may be satisfactory for potato and wheat yet produce unthrifty sugarbeet. Investigations indicate that this unsatisfactory soil condition can be remedied by applications of lime. The significant discovery was the occurrence of toxic levels of exchangeable trivalent aluminum in the top or active zone of these acid soils. Addition of lime tended to detoxify the aluminum and permit excellent growth.

RPA 208 - DISEASES AND THEIR CONTROL

1. Yellows-tolerant hybrids in use. Approximately 2 million pounds of seed have been produced of US H9A and US H9B, the first American varieties of sugarbeet to provide protection against virus yellows. In regional tests, US H9A and US H9B increased sugar yield by 22 and 27 percent, respectively, when virus yellows was moderately severe. These yellows tolerant hybrids have received wide acceptance by growers in the Western States where virus yellows is a major disease.

2. Radish juice protects against virus yellows. One or more constituents in the crude juice of radish tend to inhibit the transmission of beet western yellows virus when the virus is fed to the vector through artificial membranes. The inhibiting substance can be separated from the juice, which improves the efficiency of virus transmission. The inhibiting substances interfere with feeding of the aphid.

3. Chemical tests for resistance to virus yellows. Selection of sugarbeet based on the concentration of three amino acids in mature leaves and on root weight of infected plants grown in the greenhouse has resulted in

tolerance to virus yellows. This procedure was as effective as field selections based on disease symptoms. The precision of a chemical test for plant reaction to the virus is significant because amount and intensity of yellowing in the foliage are not reliable criteria of virus damage.

4. Virus yellows. The beet yellows virus and western beet yellows virus--both capable of inducing yellowing of sugarbeet foliage--occur in the Western States. The green peach aphid is the major vector of these viruses. Without a new charge of the western beet yellows virus, the aphid retains infectivity for only about 60 to 72 hours, whereas infectivity for the other virus persists for the life-span of the insect. Electron microscopy of viruliferous aphids demonstrated the presence of spherical particles in the lumen of the gut that were typical of western beet yellows in infected sugarbeet. No comparable particles were observed in the gut of aviruliferous aphids.

5. Influence of variety on vectors of viruses. A leafhopper, Circulifer tenellus, is the only vector of the curly top virus. Sugarbeet varieties differing in tolerance to the virus were used to study the influence of host plant on reproduction of the vector. The data show no relationship between varietal reaction to the virus and vector reproduction.

The green peach aphid is the major vector of virus yellows. A test with virus-free and virus-infected leaves demonstrated marked preference for the infected leaves.

6. Cercospora leaf spot control. Systemic fungicides are being evaluated for the control of Cercospora leaf spot of sugarbeet. Two of these fungicides have been effective against Cercospora leaf spot of sugarbeet and have shown specificity for species of the genus Cercospora.

7. Resistant varieties control downy mildew. The level of resistance of monogerm hybrids is sufficient to prevent significant damage, and at present downy mildew is of minor importance in this country.

RPA 405 - IMPROVEMENT OF QUALITY

1. Seed quality. The advantages of polyploidy have not been utilized in this country as in Europe, because poor quality of seed has been associated with triploidy. The low quality was thought to be due to the effects of environmental stress under which the seed was produced. Cytological investigations reveal that this is basically due to incomplete complements of chromosomes that may give viable gametes which produce inviable triploid embryos. This condition is self-eliminating in autotetraploids; therefore, if stabilized lines only are used as parents, triploid hybrids of good seed quality can be provided.

2. Toxic substances inhibit seed germination. Excellent monogerm seed is a prime requirement to obtain initial stands of seedlings that do not require blocking and thinning. Several chemical constituents of the sugarbeet fruits inhibit germination of seed. Phenolic compounds, nitrogenous substances, and calcium oxalate, which occur in the fruit tissue, are known to have an inhibitory effect on seed germination. These toxic substances are largely removed in the processing of seed. Research has established that the concentration of the inhibitory chemicals can be controlled to some extent by nutrition of the seed crop.

3. Respiration and quality loss. Rate of respiration in beets at harvest is highly correlated with sugar deterioration in storage. Selecting for low rate of respiration or sucrose inversion is an objective of varietal improvement.

-- Sugarcane --

RPA 307 - IMPROVEMENT OF BIOLOGICAL EFFICIENCY

A. Breeding and Genetics

1. Germ plasm. Research at Canal Point, Fla., Houma, La., and Beltsville, Md., to develop new germ plasm for the breeding program provided more than 45,000 seedlings during 1967 from interspecific and intergeneric crosses. The crosses involved four genera closely related to sugarcane and three species of Saccharum. A new technique for crossing diverse types of sugarcane as female parents and multiple males of related genera may increase efficiency of the intergeneric crossing work. Approximately 100 selected varieties from interspecific crosses made in India under a P.L. 480 project were screened for disease-resistance susceptibility in India and accepted at Beltsville, Md., for further evaluation. Out of approximately 220 seedlings, previously introduced from India, 38 remain mosaic resistant.

2. Selections. In the 1967-1968 crossing season, 283 crosses made at Canal Point provided approximately 1,315,340 viable seed to produce more than 450,000 seedlings for field evaluation in Louisiana, Florida, and the sirup-producing areas. Approximately 50% of the seedlings in Louisiana were discarded because of susceptibility to mosaic. Approximately 20,000 sugarcane seedlings were selected cooperatively in Louisiana, Florida, Mississippi, and Georgia during 1967 for further, more critical evaluation.

3. Crossing techniques. A series of photoperiod treatments at Canal Point that involved nine different arrangements of 11.5-hour dark periods during the period from September 13 to October 25 resulted in significant delay in flowering, and induced pollen production in many male-sterile clones. The maximum delay in flowering was eleven weeks; during that period flowers were available for many crosses heretofore considered impossible at Canal Point.

4. Genetic studies. Large seedling populations were studied for possible correlations among percent fiber, number and diameter of stalks, juice solids, and number of shoots in spring after first harvest. A high positive correlation was found between fiber and juice-solids. A high positive correlation between number of stalks and number of shoots in the spring after harvest indicated that number of stalks in plant cane seedlings may be a reasonably reliable index of ratooning ability in seedling populations. Other research showed there was no apparent association between distribution of vascular bundles or percent fiber and reaction to sugarcane borer in 18 varieties.

B. Physiology and Culture

1. Culture. In Louisiana there was no difference in yield of cane when the crop was cultivated one, two, or three times, where weeds were controlled with herbicides. The yield of C.P. 52-68 was reduced by herbicides. Herbicides apparently damage roots of the plants. There was a significant interaction between varieties and herbicides. Varieties did not differ in their response to time of planting for three dates: August 1, September 1, and October 1. Stalk measurements indicated that stalks were shorter and smaller in diameter when grown in 3' rows compared to 6' rows.

2. Fertilization. Data from 16 experiments in Louisiana during the period 1958-1967 show a significant increase in yield of cane (1.3 tons) and sugar (218 lbs.) per acre from 80 lbs. of nitrogen as compared to 40 lbs. for plant cane. There was also a significant increase in yield from 120 lbs. of nitrogen as compared to 80 lbs. for stubble cane; however, the high rate of nitrogen caused a significant decrease in the percentage of sucrose. Results for 1965-67 have shown no consistent significant variety x nitrogen interaction nor differences in sources or forms of nitrogen, phosphorus or potassium.

3. Flowering. In Hawaii night light interruption delayed flowering of some varieties 4 to 6 weeks. The same treatment prevented tasseling of other varieties and had no effect on date of flowering in a large group of varieties. Low night temperatures after differentiation delayed the flowering of some varieties of sugarcane as long as 2 months. Delay in flowering of many varieties helps to synchronize flowering of desirable parental clones.

4. Use of Gibberellin. April applications of gibberellin seriously reduced tillering and caused lodging of several varieties. Multiple applications of gibberellin, and a single application on June 14, resulted in longer and heavier stalks at harvest. Indicated yields of sugar per ton of cane were higher in a few instances.

5. Plant excretions. Studies in Hawaii show that sugarcane roots are a source of compounds capable of inhibiting the growth of sugarcane

seedlings. An improved rapid bioassay using sudan grass seedlings has been developed for evaluating these phytotoxins. Analysis of sterile culture medium in which cane seedlings had been growing for 3 months indicated that roots exuded into the culture medium 12 amino acids and 8 unknown compounds that were associated with the amino acid fraction.

RPA 208 - DISEASES AND THEIR CONTROL

A. Control and Effects of Diseases

1. Mosaic. In Louisiana losses from mosaic were closely related to varieties. Levels of infection that caused significant losses in L. 60-25 caused no significant losses in C.P. 52-68. Losses are related to the percent of plants infected. Varietal resistance is the only real control for the mosaic disease. Heat treatment of seedcane adequate for control of the ratoon stunting disease did not influence movement of the mosaic virus within the seed piece. There are indications that carefully controlled heat treatment may in some cases cure the mosaic disease.

A collection of mosaic made in Louisiana in 1966 has been identified as a new strain (I) of the sugarcane mosaic virus. Another mosaic isolated from johnsongrass in Louisiana was found to have symptoms not different from maize dwarf mosaic virus on several hosts. This indicates the possible role of johnsongrass as a source of mosaic virus infection of sugarcane plants. A method of differentiating strain A of sugarcane mosaic virus on sorghum differential varieties has been found.

2. Ratoon Stunting Disease. In Louisiana, the effect of ratoon stunting disease (R.S.D.) is most pronounced in reduction of yield of cane. Successive heat treatments of cane indicate that the second cycle of treatments had a beneficial effect on germination and growth of the cane. Some progress was made in developing an antiserum for the ratoon stunting disease virus at Houma.

3. Soil organisms. Data were obtained in Puerto Rico about the fungi present in the root zone area of sugarcane. Genera of fungi isolated included: Curvularia, Fusarium, Pythium, and Rhizoctonia. Pythium is one of the major growth retarding organisms in the rhizosphere. It is apparent by the effect on growth of sugarcane seedlings that some isolates of Pythium are much more virulent than others. The frequency of isolation of Rhizoctonia and Rhizoctonia-like fungi from the roots of plants showing poor growth suggests that these organisms may also significantly reduce yields. There is some evidence of interactions between nematodes, Pythium and/or Rhizoctonia.

4. Leaf Scald. Further investigations were carried out in 1967 to evaluate the effect of isolates of leaf scald (Xanthomonas albilineans) isolated in Puerto Rico in 1965, Canal Point, Fla., in 1967, and Hawaii

in 1968. All isolates were pathogenic to the host varieties tested. Co. 281 was less susceptible than B.H. 10/12 to all of the isolates. Symptoms of the disease were expressed best on 4- to 5-month-old primary shoots of the two varieties. The discovery of leaf scald in the World Collection of sugarcane at Canal Point has led to studies on the reaction of commercial varieties in Florida and Louisiana to this disease.

RPA 405 - IMPROVEMENT OF QUALITY

A. Quality and Varietal Evaluation

1. Improvement of varieties. In 1967, cooperative varietal evaluation under more than a dozen soil and growth conditions indicated the superiority of three varieties in Louisiana, C.P. 61-37, L. 61-67, and L. 62-68, and three in Florida, C.P. 56-63, C.P. 57-614, and C.P. 63-588. In addition, two varieties, C.P. 62-258 and C.P. 63-306, have given promising results in field experiments in Louisiana and Florida. C.P. 67-500 is a potential new variety for sirup and will be released in the fall of 1968.

2. New varieties. Three new varieties were released to the Florida industry during 1967. C.P. 56-59, an early-maturing, medium-barrel, non-flowering variety was recommended for growing on the cold lands and for early harvest on warm land. C.P. 57-603, a large barrel, late-maturing, non-flowering, high yielding variety that sheds the lower leaves, is adapted to the warm lands. C.P. 59-73, an early maturing, medium-barrel, non-flowering, erect growing variety, is adapted to cold lands, has outstanding stubbling ability and some cold tolerance. C.P. 57-603 averaged 40% greater yield than the standard variety Cl. 41-223 in tons of cane per acre in plant cane and three stubble crops.

3. Cold-resistant varieties. In Louisiana freezing temperatures of 25°F on December 24, 1967, and January 14, 1968, provided an opportunity for studying cold resistance in five commercial and five unreleased varieties. Progress in developing cold-resistant varieties is indicated by the fact that no deterioration was evident in any of the varieties 45 days after the initial freeze. Approximately 50,000 seedlings from 16 crosses have been screened for cold tolerance by artificial freezing.

-- Sweet Sorghum --

RPA 307 - IMPROVEMENT OF BIOLOGICAL EFFICIENCY

A. Breeding and Genetics

1. Isogenic lines. Tracy plants, resistant to infection by Colletotrichum graminicolum, were selfed to produce seed for backcross studies in 1968.

2. Genetic studies. Evaluation of the progeny of a cross between two varieties, Williams and Sart, at Blairsville, Ga., furnished additional information about the inheritance of plant characters. In this study, maturity was controlled by a single-factor pair. Seedling color was inherited independently of maturity and controlled by a single-factor pair of genes with the red color dominant over the green. Leaf anthracnose susceptibility was controlled by two factor pairs, and these genetic factors were dependent on the factor pairs controlling maturity and seedling color. There was a negative correlation between seed weight and Brix in early and late-maturing plants of the progeny. In general, early maturing lines had a lower juice extraction, a lower Brix, and greater seed weight.

3. Hybrid varieties. Investigations were continued at Meridian, Miss., to evaluate the potential of hybrid varieties for growth capacity and juice quality. There are indications that crosses of varieties that produce high yields do not exhibit hybrid vigor in height or stalk weight. When one of the parent varieties in the cross has anthracnose resistance, the hybrid variety will also have resistance. There is no evidence of true hybrid vigor for juice quality. Hybrid varieties from high quality, disease-resistant parents have a tendency to be inferior to the parents in quality of juice as determined by Brix, sucrose, and purity.

B. Physiology and Culture

1. Dates of planting. In Mississippi, sweet sorghum planted on April 17 and May 15 produced higher yields of stalks per acre than plantings in June. There was no significant difference in quality of juice from any of the dates of planting or dates of harvest.

2. Width of row. In Mississippi, sorghum planted on 20-inch rows produced significantly more tons of stalks per acre than did plants on 40-inch rows. Brix and sucrose were significantly higher in plants grown on 40-inch rows; consequently, yields of sugar per ton of stalks were also higher with plants on 40-inch rows. Lodging was much more severe with plants on 20-inch rows.

3. Leaf removal. Leaf removal prior to milling sweet sorghum stalks can be accomplished by cutting the stalks into 4-, 8-, or 16-inch lengths. Juice quality of cut stalks was similar to that of whole stalks when harvested and milled the same day, or stored 24 and 48 hours.

RPA 208 - DISEASES AND THEIR CONTROL

A. Control and Spread of Disease

1. "Mosaic." A "mosaic" disease of sweet sorghum was observed at five locations, Blairsville, Ga., Quicksand, Ky., Castorville, Tex., State College and Pontotoc, Miss. There are two principal types of symptoms:

(1) a yellow-green mosaic pattern on the whorl leaves typical of sugarcane mosaic, and (2) a brilliant red mottled streaking of the whorl leaves. Mosaic symptoms similar to those observed on sweet sorghum were also found at Blairsville, Ga., on sweet corn, johnsongrass, and other crop plants. The mosaic disease was readily transmitted mechanically, and by aphid vectors Rhopalosiphon maydis and Dactinotus ambrosiae. Tests with several varieties of sorghum and corn have shown that mosaic isolates from six locations are distinct individual isolates. Commercial and unreleased nursery varieties differ in field resistance to mosaic and degree of stunting from the disease.

2. Bacterial soft rot. A bacterial soft rot of sweet sorghum, tentatively identified as Erwinia dissolvens was observed at Meridian in 1967. Infected stalks become soft, develop hollow areas, and eventually die. The disease is apparently influenced by temperature as infection was obtained only during hot weather.

3. Disease survey. Pathological observations in variety tests and field plantings of sweet sorghum throughout Mississippi, Alabama, Georgia, South Carolina, Kentucky, Louisiana, and Texas indicate that red rot (Colletotrichum graminicolum) and zonate leaf spot (Gloeocercospora sorghi) are widespread. Bacterial stripe (Pseudomonas andropogoni) is prevalent under some conditions. In Texas severe damage was caused by insecticide sprays; the effect of insecticides differ with varieties.

RPA 405 - IMPROVEMENT OF QUALITY

A. Quality and Varietal Evaluation

1. New varieties. Data from 20 regional experiments show that two varieties, Mer. 64-12 and Mer. 65-12, are superior in several characteristics for sirup production. Two varieties, Mer. 64-3 and Mer. 64-7, are similar to Rio as sugar varieties and included in advanced field tests. Mer. 64-12 will possibly replace Tracy as a mid-season maturing variety. It is resistant to anthracnose and has less starch in the juice than Tracy. A new variety, Brandes, was released to growers. This variety is resistant to anthracnose and other important diseases, high yielding, makes good quality sirup, and is superior in lodging resistance. Brandes is susceptible to insecticide damage; therefore, it is not recommended for certain areas.

Publications - USDA and Cooperative Program

-- Sugarbeet --

RPA 307 - IMPROVEMENT OF BIOLOGICAL EFFICIENCY

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RPA 405 - IMPROVEMENT OF QUALITY

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-- Sweet Sorghum --

RPA 307 - IMPROVEMENT OF BIOLOGICAL EFFICIENCY

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RPA 405 - IMPROVEMENT OF QUALITY

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WEED AND NEMATODE CONTROL
Crops Research Division, ARS

USDA and Cooperative Programs

Location of Intramural Work	Scientist Man-Years FY 1968
Weed Control	
Colorado, Ft. Collins	1.7
Louisiana, Houma	1.0
Washington, Prosser	0.9
Total Weed Control	3.6
Nematode Identification, Biology and Control	
California, Salinas	1.0
Louisiana, Baton Rouge	0.8
Utah, Logan	1.5
Total Nematode Identification, Biology and Control	3.3
Total	6.9

NOTE: The locations shown above indicate research conducted on weeds and nematodes that pertain to sugar crops; however, at some locations the scientist-man-years of effort may include some work on other crops.

Problems and Objectives

Effective and safe weed control is essential to the continued production of sufficient food, feed, and fiber to meet the increased requirements of our rapidly growing population. All methods of control--cultural, mechanical, biological, and chemical--must be employed to minimize crop losses due to weeds. For the foreseeable future, however, herbicide control measures, alone or in combination with other methods, offer the greatest promise for economically and effectively controlling problem weeds. In addition to effectiveness, herbicide measures must be rigidly evaluated for their safety with respect to lack of contamination of harvested crops and environment, and absence of harmful persistence in soils at levels which affect succeeding crops.

On the more than 215 million acres harvested annually for the major agronomic crops, the six most important weeds and percent of the total agronomic acreage on which they are considered major problems are as follows: foxtails (28%), pigweeds (23%), wild mustard (13%), johnsongrass (8%), morningglory (7%), and Canada thistle (5%).

Weeds harbor insects that attack crops or transmit diseases to crops, and serve as alternate hosts of disease organisms and nematodes. Successful mechanization of the sugarbeet crop is impossible until some effective control is obtained on both broadleaf weeds and grasses. Grass eradication in sugarcane continues to be the major weed control problem due to the susceptibility of sugarcane to damage from herbicides effective on grasses.

Major objectives of weed research are to:

1. Discover new principles and develop new and improved chemical, cultural, biological, mechanical, and combination methods of controlling weeds in plantings of agronomic and horticultural crops; also those on grazing lands and those occurring under aquatic conditions.

2. Determine sites and mechanism of action of herbicides and the basis for their selective action in weed and crop species.

3. Develop proper methods of analysis for herbicides, metabolites and degradation products in plants and determine the effects of environment on the degradation of herbicides applied to all types of crops.

4. Determine the effects of climate, cultural practices, and soil composition on herbicide performance, persistence, and selectivity.

5. Determine factors which influence the germination, growth, and development of major weeds and to evaluate various stages of growth for susceptibility to control measures.

Nematodes attack all crop plants, and cause varying damage and crop losses, but losses are estimated at nearly 1-billion dollars annually. Most plant-parasitic nematodes infect roots and other underground parts of plants, but some attack bulbs, stems, leaves, and flowers. Damage initiated by nematodes is often extended by bacteria, fungi, and viruses. Damage can be reduced by use of varieties resistant to nematodes, but only a relatively few are available. Development of resistant varieties is time-consuming and does not completely protect the crop because multiple nematode resistance is difficult to attain and is lacking in all varieties thus far developed. Crop rotations have been devised to reduce some of our more important nematode problems, but rotations rarely fit modern management practices, or may be uneconomical. While naturally-occurring biological agents undoubtedly have a great influence on nematode populations, manipulation and use of these principles for economic control is not practical.

In sugar crops the extent of damage by nematodes is not known except that serious economic losses occur. Studies are needed on nematodes in sugar crops to determine the extent of damage and their relationship to soil pathogens and modes of control.

Major objectives of nematology research are to develop a basic understanding of the biology and control of the more important nematodes causing the most critical crop losses. The objectives are:

1. Study the identification and distribution of nematodes.

2. Investigate the physiological relations of nematodes to plants, including nature of resistance.

3. Evaluate susceptibility and resistance of crop plants, and factors determining or modifying pathogenicity.

4. Determine interrelationship of nematodes and plant diseases.

5. Develop cultural and biological control practices, as related to crops, soil, and environmental factors, that will reduce nematode losses.

6. Improve chemical control practices and determine the toxicity of nematocides to nematodes and crop plants.

Progress - USDA and Cooperative Programs

A. Weed Investigations

1. Sugarbeet-Kochia competition. One kochia plant per 25 feet of row

reduced the yield of sugarbeets by about 8 percent in Colorado. Percentage of sucrose in sugarbeets was not reduced significantly by competition with kochia until the infestation reached two kochia plants per foot or row. Stand of sugarbeets was not reduced until the infestation reached one kochia plant per foot of row.

2. Control of weeds in sugarbeets. In Colorado about 80 percent of a mixed population of foxtail, lambsquarters, and pigweeds can be controlled with currently registered herbicides applied before planting. About 90 to 95 percent of these three weeds can be controlled with a postemergence mixture of pyrazon plus dalapon used in combination with a preplanting treatment. These treatments, however, do not adequately control kochia. A new herbicide, benzadox, controls up to 80 percent of the kochia when applied as an early-season postemergence treatment. An application for registration and a petition for a finite tolerance for benzadox have been made.

Preplanting treatment with cycloate increased susceptibility of sugarbeets to postemergence application of a mixture of pyrazon plus dalapon. Likewise, an application of cycloate before planting sugarbeets increased the susceptibility of kochia to postemergence application of benzadox. Response of sugarbeets to the treatment appeared temporary and yields were not reduced.

The best selective weed control in sugarbeets with the herbicide cycloate in Washington resulted from thorough incorporation to depths of 3 inches. Placement of the herbicide in a layer 2 inches beneath the surface increased the herbicidal activity on both weeds and sugarbeets. Injection of the herbicide in two lines on each side of the drill-row provided only slightly less effective control than thorough incorporation, and reduced loss of moisture from the seedbed which often occurs from thorough incorporation.

The herbicides pyrazon and propachlor do not appear safe for control of weeds in sugarbeets under Washington conditions.

3. Control of weeds in sugarcane. Neither fenac, terbacil, nor picloram reduced the yield of sugarcane in Louisiana when the herbicides were applied in three successive applications over a 2-year period. Varieties of sugarcane exhibited a differential tolerance to multiple applications of either fenac or terbacil. Two applications of MSMA to the foliage of established johnsongrass was more effective than two applications of dalapon. More rhizomes were killed with MSMA than with dalapon. This suggests that the organic arsenical herbicides can be translocated to underground organs of treated weeds. Sugarcane was moderately injured by two applications of MSMA, but the yield was equivalent to that of sugarcane receiving a standard herbicide treatment. Trifluralin controlled johnson grass seedlings effectively without injury to sugarcane. Also, trifluralin was one of only two herbicides that controlled Raoul grass effectively. It did not control broadleaf weeds, and a split application involving fall and spring treatment was no more effective in control of johnsongrass than a single application made in the spring only. Yield of sugarcane was not affected by rates as high as 3 lb/A.

B. Nematodes in Sugar Crops

In the absence of nematodes, Fusarium oxysporum was not pathogenic on sugarbeet in the presence of Heterodera schachtii or Meloidogyne hapla. The damage caused by Heterodera schachtii was as severe as the damage caused by both the nematode and the fungus. However, in the case of root-knot, the combined damage of Meloidogyne hapla and Fusarium oxysporum was greater than the damage caused by the nematode alone. In field plot tests in Utah, Temik increased sugarbeet yield 4.75 tons per acre more than DDT treatments. The performance of this new carbamate nematocide in controlling sugarbeet-cyst nematodes was spectacular and unusual because few chemicals, other than DDT, are effective in controlling these nematodes.

Publications - USDA and Cooperative Programs

None reported that deal specifically with sugar crops--for a list of publications reporting research on weeds and nematodes see Section B, Progress Report of the Crops Research Division, ARS, July 1, 1968.

SUGARCANE AND SUGARBEET INSECTS
Entomology Research Division, ARS

USDA and Cooperative Program

Location of Intramural Work	Commodity	Scientist Man-Years FY 1968
Idaho	Sugarbeets	1.8
Washington	Sugarbeets	3.3
Louisiana	Sugarcane	3.0
Florida	Sugarcane	1.0
Total		9.1

Intramural program is supplemented by extramural support representing 3.1 SMY at State Agricultural Experiment Stations and PL 480 funds in one country totalling about $20,000.

Problems and Objectives

Many species of insects cause losses amounting to millions of dollars annually to sugarcane and sugarbeets through direct feeding damage and/or damage from diseases spread by insects. Surveys show that the sugarcane borer alone causes an annual loss exceeding $5 million. Comparable losses in sugarbeets can be attributed to sugarbeet root maggot, beet leafhopper, and beet webworm. Sugarcane mosaic continues to cause losses amounting to millions of dollars annually. Beet yellows and associated western yellows virus disease of sugarbeets transmitted by insects continue to threaten the sugarbeet industry. Emergency control methods for vectors of the viruses of these diseases are urgently needed. Reducing crop losses in sugarcane and sugarbeets due to insect damage and diseases they cause could result in annual net benefits of at least $20 million.

Major objectives of the research are to develop and utilize:

1. Knowledge of the biology and ecology of insects.
2. Varieties resistant to insect pests.
3. New approaches to insect control.
4. Safe insecticides that will control insects and insect vectors of diseases, but do not leave harmful residues.
5. Methods to eliminate the weed reservoirs of insect vectors.

A. Basic Biology, Physiology, and Nutrition (2.3 SMY)

1. Sugarbeet

a. Sugarbeet root maggot. At Paul, Idaho, the sugarbeet root maggot overwintered in the larval stage, with 55% found in the 6 to 9-inch layer of soil, 30% at 3 to 6 inches, and the remainder below 9 inches. The maggots began an upward movement in mid March and 68% were found in the upper three inches of soil by April 30, 93% of which were in the pupal stage. The first fly emergence was noted on April 28, and the peak was reached on May 29. Raw beet juice was the most attractive to adults of several materials tested, and fermenting juice is more efficient than fresh juice.

The diapause chilling requirement of the root maggot can be met by a 2-month cold-storage treatment. Good egg production and viability has been obtained by feeding the adult flies a diet of Brewer's yeast, sugar, and water.

b. Aphids. A mechanical trap utilizing yellow baffleplates for impaction surfaces and bottles of a dilute formaldehyde preservative was developed at Yakima, Wash., for determining hourly, as well as longer, periods of flight activity of the green peach aphid. Most flights occurred during daylight and twilight hours of the day. Temperature was a lesser deterrent than wind to aphid flight.

2. Sugarcane

a. Sugarcane Borer. Survival in Louisiana for the winter 1966-67 was 81.5% compared to 11% for 1965-66. First generation counts in May-June showed an estimated average of 2297 borer-killed plants per acre compared to 1390 in 1966.

The harvesttime infestation averaged 16% of the joints bored. Infestations during five previous years were 14% in 1966, 18 in 1965, 11 in 1964, 12 in 1963, and only 6 in 1962 following one of the coldest winters in this century in Louisiana. Percentage of joints bored for 1935-66 averaged 16%. The 4400 stalks examined in 1967 harvesttime survey had 55,793 joints compared to 51,819 in 1966 when an early freeze necessitated lower than normal topping of the crop. Estimated crop loss resulting from borer injury was 12% in 1967.

The Florida sugarcane borer harvesttime survey indicated an overall average of infestation (joints bored) of 6.5%. This compares with 2.4% for 1966-67, 4.0% for 1965-66, and 6.4% for 1964-65. This represents a loss or reduction in production of some 49,853 tons of raw sugar for the 1967-68 season. Populations of the "cane fly" or West Indian sugarcane delphacid reached a high population level on approximately 100,000 acres in January and February, some stunting of younger cane resulted. Wireworms continue to be a problem in Florida.

Losses to the sugarcane crop in Florida due to borer injury were studied on 105 split-plots of sugarcane grown under two controlled levels of borer infestation (high and low). The high level had an average bored-joint infestation of 62% and the low level of 40%, a difference of 22%. This difference caused a total loss of 1869 pounds of sugar per acre. Seventy-four percent of this total (1381 pounds) was lost in the field while only 26% (488 pounds) was lost in the factory. Of the 74% field loss, 54% (1015 pounds) was due to lighter-weight stalks and 20% (366 pounds) to fewer stalks per acre. From the 26% loss in the factory, 14% (260 pounds) was due to lower sucrose, 3% (56 pounds) to lower purity, and 9% (172 pounds) to reduced extraction.

b. Yellow Sugarcane Aphid. Infestations of the yellow sugarcane aphid, Sipha flava, increased enormously in all fields in Louisiana where carbaryl was applied for borer control. A grass worm, Cisseps fulvicollis, caused economic injury to young sugarcane in spring of 1966 for first time in Louisiana.

B. Insecticidal and Cultural Control (3.2 SMY)

1. Sugarbeet

a. Sugarbeet Root Maggot. At Rupert, Idaho, granular formulations of Bay 37289, Bay 25141, diazinon, Niagara NIA-10242, phorate, Stauffer N-2790,

and Union Carbide UC-21149 applied to sugarbeets in a 6-inch band at planting time gave better than 95% control of sugarbeet root maggot.

Sprays of azinphosmethyl, Bay 39007, diazinon, and dimethoate applied by ground equipment to sugarbeets when the sugarbeet root maggot flies were emerging gave good control of the maggots and yield increases.

Three airplane applications of ultra-low-volume malathion at the rate of eight ounces per acre to an isolated 584 acres of sugarbeets reduced adult fly population 97% and gave a 3-ton increase in yield in 1967. In 1968, 200 acres near Minidoka, Idaho, were sprayed the same way. However, unfavorable weather retarded beet germination, and the beets were in the cotyledon stage when the flies emerged. With such a scarcity of foliage, very poor control was obtained. Ultra-low-volume malathion dissipates very rapidly when there is not much foliage present.

b. Aphids. At Yakima, Wash., greenhouse tests simulating early spring conditions during which seeding and sidedressing of sugarbeets with systemic insecticides for aphid control may start with soil temperatures near 40° F showed that the insecticide dissipated during the 42-day germination period and failed to prevent establishment of colonies of the green peach aphid, Myzus persicae. However, when the soil temperature was raised to 50° F at seeding and sidedressing, 100% control was obtained for about three weeks after plant emergence.

Foliage applications of phorate controlled the green peach aphid for nine weeks and UC-21149 for 16 weeks; phorate controlled the potato aphid for ten weeks, and UC-21149 for 12 weeks.

c. Leaf Miner. At Yakima injury to sugarbeet leaves from a leaf miner was reduced materially by one pound of either phorate 86%, Azodrin 83%, demeton 80%, or carbophenothion 76% in 24 gallons of water per acre.

Gravid females of one leaf miner species were not repelled whereas gravid females of another leaf miner species were repelled for nearly two weeks by seven different organophosphorous sprays.

2. Sugarcane

a. Sugarcane Borer. Thuricide at 1-1/2 quarts per acre gave good sugarcane borer control, with 2.3% joints bored; Azodrin at .5 pound per acre had 3.7% joints bored; endrin at .3 pounds per acre 4.4% bored joints; check plots had 6.2% bored joints.

Average net tons per acre of sugarcane harvested from plots treated with insecticides at time of planting for control of wireworms, Melanotus communis, in heavily infested muck soil are as follows: check (no treatment) 9.1 tons; Chevron RE-5353, 2.7 pounds actual per acre in granules (G), 17.8 tons; Ortho 9006, 2.7 pounds (G), 25.1 tons; parathion, 4.6

pounds (G), 32.8 tons; Mocap 1.6 pounds (G), 33.9 tons; diazinon 4.0 pounds in emulsifiable concentrate (EC), 40.0 tons; diazinon 4.0 pounds (EC), 40.6 tons; Akton, 2.0 pounds (EC), 41.9 tons; Dasanit 3.8 pounds (G), 43.1 tons; carbofuran 3.8 pounds (G), 43.2 tons; Dyfonate 3.8 pounds (G), 47.9 tons.

Eighteen chemicals were evaluated against the sugarcane borer in three small plot and four airplane experiments. Percentages of controls, based on bored joint (internode) infestation, ranged from 5 to 94. Abate at one pound per acre in an airplane experiment gave 80% control compared to 81% for Azodrin and 69% for azinphosmethyl.

Low volume concentrates of Azodrin and azinphosmethyl at .75 pound per acre in an airplane experiment gave controls of 69% and 77% compared to 85% and 84% for the respective insecticides conventionally applied and 83% for azinphosmethyl in granular formulation at one pound per acre.

Maximum borer mortality in leaf sheaths, attained one week after insecticidal application, were 98% for Azodrin, 96% for azinphosmethyl, and 74% for carbaryl. Live borer counts were high in all treatments three weeks after application.

Azodrin and azinphosmethyl in herbicidal-combinations of 2,4-D and Silvex gave high effective borer and tie vine controls. Borer control obtained with the two 2,4-D-insecticidal treatments was slightly higher than the corresponding insecticidal treatment alone.

C. Biological Control (1.6 SMY)

1. Sugarbeet

The Pacific brown lacewing was more abundant than predaceous Typhlodromus mites on sugarbeets infested with the two-spotted spider mite at Yakima, Wash. It seldom visits sugarbeets until mite colonies have been established and then deposits one or more glistening, white eggs within or near the webbed-in mite colony. Infested leaves have often been freed of mite infestations by this agile searcher.

2. Sugarcane

a. Sugarcane Borer. Laboratoty tests at Canal Point, Fla., showed that virgin females laid an average of 192 eggs and mated females laid an average of 331 eggs. The sterile eggs were unsuitable for Trichogramma development. Eggs sterilized by heat were suitable for Trichogramma development in the laboratory but apparently were not parasitized in the field.

Studies conducted in 1967 to determine if effectiveness of natural Trichogramma populations could be substantially increased by adding to the

the environment large numbers of fresh sterile sugarcane borer eggs on a sustained basis showed no significant differences between the arbitrarily selected high and low egg density levels for either percent parasitism or borer infestation. Parasitism in the high host egg density level did not increase as the experiment progressed and at the conclusion of the experiment was only 3%.

Studies conducted at West Palm Beach, Fla., to determine the degree of parasitism by Lixophaga diatraea, in relation to borer population showed that the release of five female parasites per acre in a field infested with 100 borers produced 21% parasitism; 5 to 500 borers, 6%; 25 to 100 borers 14%, and 25 to 500 borers, 3%. Parasitism in check plots (no release) of 100 borers, 10%, and 500 borers, 2%.

Additional studies using higher release levels in young (24 inches high), first year ratoon cane, increased percent parasitism as follows: 50 parasites (25 female) per acre with 100 borers 85% parasitized; 50 parasites with 500 borers 70%; 250 parasites with 100 borers 94%; and 250 parasites with 500 borers 86%. One non-release check plot had 32% parasitized borers, but non-release 100 and 500 host borer plots each yielded 0% parasitized borers.

The parasites Apanteles flavipes and Agathis stigmaterus are now established over the sugarcane growing area of Florida. Both are most abundant on the eastern and western fringes of the production area. Trichogramma sp., an egg parasite is established on the sandland areas. Levels of parasitism ranged from 2% - 20% for Agathis with an average of near 14% for the area. Apanteles parasitism ranged between 3% in the central growing area to 10% on the eastern sandlands to 98% in one small field southwest of the main growing area.

Introduced parasites which have been successfully reared on D. saccharalis in the laboratory were Paratheresia claripalpis and Plapozenillia sp. (Bolivian strain).

D. Varietal Evaluation for Insect Resistance (0.9 SMY)

1. Sugarcane

a. Sugarcane Borer. In the 1967 preliminary screening tests at Houma, La., for borer resistance were conducted on 186 sugarcane varieties in single field plots under conditions of artificial infestation. Three of these, H. 61-55, H. 61-207, and H. 61-577, showed superior borer resistance and sugar production.

In advanced replicated field tests 27 unreleased sugarcane varieties and one control variety were artificially infested in 1967. Results of this test showed three varieties, CP. 65-433, CP. 66-491, and L. 61-43 to be outstanding in both borer resistance and sugar production. Of these three

varieties CP. 66-491 has the best record, and has been consistently good in both borer resistance and sugar production in all tests conducted over a three-year period.

Progeny from basic crosses and backcrosses involving wild (Saccharum spontaneum and S. robustum), cultivated canes, and basic crosses from the Sugarcane Breeding Institute at Coimbatore, India, were grown and evaluated for borer resistance at Houma, La., under conditions of artificial infestation. Three varieties from Canal Point, Fla., and 18 from India with low infestation readings were saved for retest as promising borer resistant varieties.

E. Insect Vectors of Disease (1.1 SMY)

1. Sugarbeet

a. Beet Leafhoppers. Losses of sugarbeets rrom curly top, transmitted by the beet leafhopper were more severe in eastern Washington in 1966 and 1967 than for many years. Although only resistant sugarbeets were grown, the resistance was not sufficient to cope with unusually large populations of leafhoppers and an extremely virulent strain of the virus.

Replacing the Russian-thistle with crested wheatgrass or rangeland in the Magic Valley of Idaho has reduced the population of beet leafhoppers to one of unimportance in recent years.

In western Idaho and eastern Oregon where large acreages of sagebush have been sprayed and seeded to grass by the Bureau of Land Management, germination has been poor. Russian-thistle has taken over these areas and large populations of leafhoppers were produced last year. The sugarbeets in this area are showing a very high incidence of severe curly top. Some fields may lose as much as 25% of the plants to curly top.

b. Aphids. Fifteen lots of sugarbeet roots from plants heavily infected with beet western yellows examined at Yakima, Wash., contained approximately the same percentage of sucrose. The sucrose content in noninfected beets ranged from 14.1 to 17.7% (average 15.3%) and infected beets from 12.6 to 17% (average 15.1%).

2. Sugarcane

A new strain of sugarcane mosaic virus has spread into the important commercial varieties. In some fields almost 100% of the plants are infected. Chemical control studies conducted on insect vectors of sugarcane mosaic virus and of preferred wild host plants of some of the more common vectors indicate that seven applications of diazinon and TDE both alone and with a spreader-sticker, reduced vector populations by 43 to 100% but had no effect on mosaic spread. Four applications of 2 pounds DDT plus 4 pounds toxaphene with a spreader-sticker and of demeton gave 81

and 84% reductions in vector populations, respectively, and reduced mosaic infection by 22%. The DDT-toxaphene spray alone gave a 91% reduction in vector populations and a 78% reduction in mosaic infection. The rusty plum aphid, Hysteroneura setariae, the only vector species for which sugarcane is a natural host, was controlled 100% with all insecticides.

Publications - USDA and Cooperative Program

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Insecticidal and Cultural Control

Peay, Walter E., Stanger, Charles E., and Swenson, A. A. 1968. Preliminary evaluation of soil insecticides for sugar-beet root maggot control. J. Econ. Entomol. 61: 19-21.

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Tamaki, George, and Weeks, R. E. 1968. Anthocoris melanocerus as a predator of the green peach aphid on sugar beets and broccoli. Ann. Entomol. Soc. of Amer. 61: 579-84.

Tamaki, George, and Halfhill, J. E. 1968. Bands of peach trees as shelters for predators of the green peach aphid. J. Econ. Entomol. 61: 707-11.

Insect Vectors of Sugarcane Diseases

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MECHANIZATION OF SUGARCANE HARVESTING
Agricultural Engineering Research Division, ARS

USDA and Cooperative Program

Location of Intramural Work	Scientist Man-Years FY 1968
Sugarcane	
Florida	2.0
Total Sugarcane	2.0

Problems and Objectives

In considering the three major items of capital outlay for the production of food and fiber crops--land, building, and machinery--it is generally conceded that the machinery costs exceed the others by a wide margin. Improvements and changes in present day farm machinery are continually taking place in order to adapt to new varieties, improved production practices, a need for higher efficiency, and changing handling and storage practices. The cost of owning and operating field equipment for most crops is the major expense of production, in some cases, amounting to nearly half the total returns to the producer from the sale of the crop. Harvesting equipment is the most sophisticated and highest cost of all agricultural machinery, requiring expert attention by the operator during its period of use. The four billion man-hours of labor and the six billion dollar machine costs used annually in operating American farms offers ample potential for fruitful results.

The major objectives of research on the mechanization of field crops include:

1. The development of machinery and improved machine components to plant, cultivate, harvest, and handle specific crops in order to minimize power requirements, reduce the number of field operations and provide optimum seedbed, growing, and harvesting conditions.

2. The development of precision devices and automated systems that reduce labor requirements.

3. The determination of the rheological properties of crops that relate to the harvesting, handling, and processing in order to design and adopt labor saving devices.

4. The modification of varieties and cultural practices to provide plants more easily adapted to mechanized operations and labor saving devices.

5. The development of more efficient automated systems that encompass all field and post harvest operations that handle, cure, dry, clean, gin, or otherwise prepare the crop for market.

Progress - USDA and Cooperative Programs

Sugarcane

1. Harvesting recumbent cane. Field tested several designs of cleaners for removing extraneous matter such as tops, leaves, and soil from sugarcane. Approximately 50 percent of the trash was removed from cane con-

taining 29 percent trash standing in field and 24 percent after burning. In some tests, trash contents were reduced to the range of 8 to 14 percent. A topping system using 90 durometer rubber spiral rolls was tested. A topper lifted the leaves and pulled the tops into the rolls where they were broken, or the spirals conveyed them into a cutting blade. The rolls contacted only about 25 percent of the tops. A final design of the auger harvesting system using a 30-inch diameter upper auger and an 18-inch diameter lower auger was tested and operated efficiently. This design is satisfactory for the heavier recumbent canes grown on flat land. Horsepower requirements were very low compared with other harvesting systems. Types of square rolls, round rolls, spiral steel rolls, and spiral rubber rolls were used for cleaning in the conveyors. Agitation or tumbling of cane was not as good with the conveyor slats traveling over the rolls. Further tests were made with the notched-tooth cleaners in the conveyor. About 25 percent of the total trash in burned cane was removed by the rolls and notched-tooth cleaners in the conveyor. High-speed photographic studies were made on auger oriented fingers, cones, polygon roll cleaners, pneumatic trash systems, and on a chopping system. Results of the pneumatic cleaning studies indicate that air should be applied in the opposite direction from common practice to take advantage of centrifugal force differences on cane and trash.

2. Top and trash removal. Contract research was completed on developing and testing laboratory models of trash removal devices to produce cane for mill processing having a mixiмum of 5 percent extraneous material and a minimum of 95 percent millable cane. Methods that were investigated included pneumatic separation, controlled burning, experimental belts, notched tooth drum, and cleaning rolls of several configurations. Polygon shaped cleaning rolls studied under this project offer the greatest potential of any of the methods studied. The rolls are adapted for removing leaf trash, some immature tops, soil, and other extraneous material. However, they do not separate large rocks. The condition of the trash on the cane does not seem to affect the performance of the rolls. A large percentage of the trash is removed regardless of whether the material is green, dry, or wet. Immature cane is removed from the mature cane providing the immature stalk is grabbed by the cleaning rolls. Of the three shapes of polygon rolls tested, square and hexagonal rolls were the most effective. Optimum rotating speeds for the rolls is considered to be approximately 600 r.p.m. The optimum size of the rolls will vary depending upon the shape. The pocket formed by a pair of rolls should not exceed the average diameter of the cane being cleaned. The polygon cleaning rolls could be used within any system of the harvesting and milling operation.

Publications - USDA and Cooperative Program

Sugarcane

COCHRAN, B. J., and CLAYTON, J. E. Basic studies of mechanical trash removal from harvested sugarcane. Proceedings International Society of Sugarcane Technologists. March 1968.

CLAYTON, J. E. Research on systems for harvesting and cleaning recumbent sugarcane. Sugar y Azucar. July 1968.

II. NUTRITION, CONSUMER AND INDUSTRIAL USE RESEARCH

SWEET SORGHUM UTILIZATION
Southern Utilization Research and Development Division, ARS

USDA and Cooperative Program

Location of Intramural Work	Scientist Man-Years F.Y. 1968
Texas (Weslaco)	
Chemical Composition and Physical Properties	1.2
Total	1.2

Problems and Objectives

The Lower Rio Grande Valley, which is largely dependent on an agricultural economy, must have a greater selection of crops for diversification to meet unfavorable environmental and marketing conditions that frequently beset the area. One of the crops that has potential for providing profitable diversification is sweet sorghum, particularly since new disease-resistant varieties with high sugar content are now available. The modest water requirements of sorghum and the subtropical climatic conditions conducive to an extended growing season also increase its attractiveness. In addition, integration of processing of sorghum with that of beet and sugarcane would extend the use of costly installations in sugar factories. However, to achieve these goals, research is needed to develop practical methods for the recovery of sugar from sweet sorghum.

More specific objectives of the research are:

1. To explore chemical and physical procedures for removing nonsugars from sweet sorghum juices.

2. To develop an economical process to recover the sugar from sweet sorghum.

3. To evaluate the processing characteristics of newer sorghum breeding lines grown under different agricultural practices.

Progress - USDA and Cooperative Program

A. Chemical Composition and Physical Properties

1. Recovery of Sugar from Sweet Sorghum. All field materials from the 1967 harvests in the Weslaco and San Antonio-Winter Garden areas have been analyzed. Varieties having good yield of stalks per acre and of sugar per ton of stalks were selected for further study. Field studies also indicated that periods of heavy borer infestation are seasonal and will therefore justify more extensive control experiments. When juice clarification was followed by treatment of the dilute syrup to prevent enzymatic or other deterioration of its sugars, the starch content was reduced to insignificant levels and juice purity was further increased. Laboratory studies revealed that difficulties in juice clarification resulted chiefly from insufficient phosphate content, a situation easily resolved by the addition of phosphoric acid or calcium superphosphate. This research is conducted in cooperation with the Texas Agricultural Experiment Station and Crops Research.

Publications - USDA and Cooperative Program

None.

NUTRITION AND CONSUMER-USE RESEARCH
Consumer and Food Economics Research Division, ARS
Human Nutrition Research Division, ARS

USDA and Cooperative Programs

Research Problem Area and Location of Intramural Work	Scientist Man-Years FY 1968
Human nutritional well-being, food consumption, food quality in homes and institutions (RPA's 708, 703, and 704) 2/ Beltsville and Hyattsville, Maryland	1.0 1/
Total	1.0

1/ 1.0 man-year does not include the basic nutrition research related to dietary carbohydrates which is considered briefly in this report.

2/ See Introduction, page iii.

Problems and Objectives

Nationwide attention is focused on the need to improve the nutritional levels of some individuals and some population groups. Nutrition education and food distribution programs are being intensified and expanded. To facilitate these programs, research must continue to add to our understanding of the nutritive values of foods, the nutritional needs of people, and how their needs can best be met by food. More effective ways must be found to inform people about foods and nutrition and to help them improve their foods habits. For families and institutions, new methods of handling and preparing the continuous array of new food products must be developed so that their nutritive and other desirable qualities are retained. A continuous flow of information gained from research on food consumption and dietary levels of the population, the food management practices of families, and the factors that affect their food choices is an essential research backstop to the development and evaluation of agricultural policies and programs in food and nutrition.

Major objectives of the research are:

(1) to determine human requirements for nutrients and foods

(2) to assess the nutritive values in foods and develop representative values

(3) to evaluate food consumption patterns, dietary levels, food habits and food management practices of families and individuals

(4) to develop and improve the procedures used by consumers to prepare and handle food so as to preserve or enhance its qualities

(5) to review and interpret research findings on foods and nutrition for application to action programs and to develop guidance materials

Progress - USDA and Cooperative Programs

A. Human Nutritional Well-being

1. Nutritional Evaluation of Dietary Carbohydrates. Research in the Department and elsewhere has provided evidence that the kind of carbohydrate in the diet may influence metabolism under some conditions, and that the changes may be due to an interaction with other dietary ingredients. Research is continuing to find out more about the interactions of fats, proteins, and minerals with different kinds and amounts of carbohydrates, their effects on body composition, and on the structure and functioning of tissues at various stages of the life cycle.

(a) Effect of dietary carbohydrates on blood lipids in man. The kind of dietary carbohydrate had little effect on blood lipids during short-term studies with 9 young men and 10 young women. The men and women ate diets in which 85 percent of the carbohydrate (40 percent of the calories) was supplied by cooked wheat starch or by sucrose. No significant differences in serum levels of cholesterol, phospholipids, or glycerides were noted between wheat and sugar. Long-term studies in the Department's nutrition research have shown that fat and cholesterol metabolism in rats can be altered by the kind of dietary carbohydrate. The extent and manner of change varies with the strain and age of animal. The application of the results to humans is still to be established.

(b) Effect of dietary carbohydrates on enzymes involved in fat metabolism. The activities of three enzymes involved in fat metabolism--glucose-6-phosphate dehydrogenase, 6-phosphogluconate dehydrogenase, and pyruvate kinase--were lower in the livers of rats fed starch than in rats fed sucrose. The enzymes also were significantly less active when the diet was high in cholesterol (25 percent dried egg) than when the diet did not contain egg. In the presence of cholesterol, carbohydrate differences were still apparent but were small in comparison with the differences observed in the absence of cholesterol. The high levels of fat and cholesterol in the livers of the rats fed the egg diet do not appear to be associated with the level of activity of these enzymes.

Research carried out in Israel under a Public Law 480 grant has provided evidence that another enzyme involved in fat metabolism--lipoprotein lipase--also is influenced by the type of dietary carbohydrate. Fructose, one of the simple sugars in sucrose has been suggested as the factor responsible for the high levels of fat observed in the blood. The Israel investigators report that when the diet contains fructose, the activity of lipoprotein lipase in adipose tissue is reduced and blood fat increases. This is in contrast to the high activity of the enzyme and the lower blood fat that is found when glucose is fed. The investigations suggest that this enzyme is active in maintaining an equilibrium between adipose tissue, liver and blood. The low activity of this enzyme observed in body fat when fructose is fed upsets the mechanism controlling fat metabolism and blood fat becomes elevated.

2. Nutritive Value of Meals as Served. Type A school lunch. Twenty-lunch composites obtained in the fall of 1966 from each of 300 schools located in 19 States and five geographic regions were analyzed for seven vitamins. The lunches were identical with those served to sixth graders. On an average, the lunches exceeded the nutritional goal of one-third of the 1968 Recommended Dietary Allowances set by the Food and Nutrition Board of the National Academy of Sciences for 10 to 12 year olds for vitamin A activity, riboflavin, niacin, vitamin B_{12} and vitamin D. The average B_6 content equalled the nutritional goal. Riboflavin, which is safeguarded by the milk requirement of the Type A pattern, exceeded the goal at all schools.

Meals served in some of the schools provided substantially less of some vitamins than is desirable. Vitamin A activity, vitamin B_6, thiamine and vitamin D were the nutrients most often short in lunches which failed to meet the nutritional goals. For more than half of the schools, lunches failed to meet the goal for one or more of these four vitamins. Only a small proportion of the schools served lunches that furnished less than one-fourth the daily Recommended Dietary Allowance for one or more vitamins. Except for this small proportion, the schools served lunches that could be considered reasonably satisfactory in vitamin content.

3. Nutrition Guidelines for Food Programs. Nutrition research findings continue to be studied and interpreted for application to problems in food selection and food use. Special attention is given to providing support for action programs of the Department and of other government agencies. For example, the set of commodities made available to participants under the Direct Distribution Program was evaluated for nutritional adequacy. Also evaluated were alternative methods for improving the nutritional adequacy of the distributed commodities. These included recombination of the commodities, fortification of the commodities and the addition of new commodities. Menus using distributed commodities and based on the economy food plan are being developed for the use of leaders who work with families.

Technical assistance was given to the School Lunch Division of C&MS in the development of (1) a breakfast menu planning guide for use with the pilot school breakfast program and (2) meal patterns including minimum quantities of foods to serve, for use in special food service programs for children. An evaluation of the Type A Lunch Pattern is now being prepared using data obtained in the study of the composition of a week's lunches in 300 schools and taking into account the recently revised NRC Recommended Dietary Allowances.

B. Home and Institutional Preparation of Food

1. Low-income Families. Recipes for a broad range of commodities, including fruits, vegetables, rolled oats, cheese, nonfat dry milk, instant mashed potatoes, dry scrambled egg mix, and canned chicken were developed for use by low-income families participating in USDA food distribution programs. A pilot survey in two low-income housing developments in Washington, D. C. showed these recipes to be useful and acceptable.

2. National School Lunch Program. About 170 recipes were developed or reevaluated for the School Lunch Program. The recipes covered a wide range of commodities, including canned chopped meat, sweetpotato flakes, canned grape juice, frozen french fried potatoes, peanut butter, raisins, dried eggs, rolled oats, and concentrated orange juice. In addition, yield and quality information on new forms of foods has been obtained. This information on recipes, yield and quality is essential for school lunch managers who are in charge of feeding almost 19 million children in the National School Lunch Program.

C. Food Choices, Habits, and Consumption

1. Food Consumption and Dietary Levels - 1965 Nationwide Survey.

(a) Quality of Diets. Amounts of food used in U. S. households in 1965 were sufficient, on the average, to provide diets meeting the NRC Recommended Dietary Allowances. Half of the households had diets that met the allowances for all nutrients. These diets were rated "good." The other half of the households had diets that failed to meet allowances for one or more nutrients. Calcium, vitamin A value, and ascorbic acid were the nutrients most often found to be below allowances. About one-fifth of the diets provided less than two-thirds of the allowances for one or more nutrients. These diets were rated "poor."

At each successively higher level of income, a greater percentage of households had diets that met allowances. High income of itself, however, did not insure good diets. More than one-third, 37 percent, of households with incomes of $10,000 and over had diets that were below the allowances for one or more nutrients. Almost two-thirds, 63 percent, of the households with incomes under $3,000 had diets that did not meet allowances for one or more nutrients. Over one-third, 36 percent of the households with incomes under $3,000 provided less than two-thirds of the allowance for one or more nutrients and rated poor. At this income level, poor diets were most frequent among urban households in the North Central and rural households in the South.

Fewer households had good diets in 1965 than in 1955--50 percent in 1965 and 60 percent in 1955. The proportion with poor diets increased over the 10 year period from 15 percent in 1955 to 21 percent in 1965. Decreased use of milk and milk products and vegetables and fruit, the main sources of calcium, ascorbic acid, and vitamin A value, was chiefly responsible for these changes in dietary levels.

Estimates of the concentration and location of households with poor diets by state and county were derived by statistical methods from the 1965 nationwide food consumption survey data in conjunction with Census statistics on population and income. A relatively high proportion of poor diets was found in the counties of the South and North Central Region. No county had more than 30 percent or less than 9 percent of its households with poor diets. Counties with the greatest number of households with poor diets were those with large metropolitan areas. These estimates were made in response to a request by the Committee on Agriculture, U. S. House of Representatives, in their hearings on the Stennis Bill to provide Food and Medical Services on an Emergency Basis. The estimates were published in a report to the Committee along with an evaluation of published reports on clinical and biochemical studies of nutritional status.

(b) Food Use by Farm and Urban Households. Both farm and urban households have shared in changes in food consumption in recent years but farm households have made more changes than urban in their use of all the major food groups except vegetables and fruit. As a result, farm households have become more like urban households in the foods they use. In spring 1955, farm households used 19 percent more milk than urban but only slightly more (4 percent) in spring 1965. Farm households used 7 percent less vegetables and fruits than urban families in 1955; only 3 percent less in 1965. Farm households used 33 percent less purchased bakery products per person a week in 1955, but only 18 percent less in 1965. The largest difference still exists in the use of flour and cereals. In 1965 farm households were still using more than twice as much as urban families. Continued greater use of fats and sugars by farm families is partly related to their greater use of flour and cereals. On the other hand, farm families continue to use considerably less than urban families of soups and other purchased mixtures. Some of the shifts in food habits of farm families have resulted from the decline in their production of food for home use.

(c) Use of Convenience Foods. A large proportion of the food dollar went for convenience foods in 1965 than a decade ago. In 1955, 27 percent of the grocery bill went for 32 types of items that were classed as convenience foods. Included were all types of canned and frozen fruits, vegetables and juices; frozen, canned and dried potatoes; ground beef, frankfurters and other lunch meat; mixtures and soups; prepared flour mixes, bakery products (including purchased bread) and breakfast cereals; instant coffee; fruit ades and punches; canned and dry milk; frozen desserts; and commercially prepared puddings, pie filling and icings. By 1965, the part of the grocery bill that went for these same items had increased to 30 percent. The percentage increase was greater for low- than high-income families. By 1965 low-income families were spending a slightly higher percentage of their money on these convenience foods than were the higher income groups. Farm families had upped markedly the proportion of their grocery money spent on convenience foods, in part because they were buying so much more of their food and producing less.

2. Food Acceptance and Food Habits. The amounts of foods consumed and rejected in type A school lunches by 10th grade girls and boys at four Louisiana high schools were determined from the weights of foods served and the weights left on trays on three successive days. Boys consumed more of all foods except vegetables than girls. The highest percent of waste was noted in the vegetable group (approximately 50 percent) and the second highest in fruits (30 percent). There was little waste of milk and desserts. Acceptance of certain items differed in different schools. This may have been due to different methods of preparation.

3. Nutrition Program Service. An intensified nutrition education program was initiated following release of the findings of the study on dietary levels of U. S. households surveyed in the spring of 1965. State nutrition committee chairmen were advised of the need for this program and were urged

to take part in it. Nutritionists in states not having a committee were urged to form one. Assistance was provided seven states in developing nutrition education programs. Three workshops were developed; 3 seminars and 10 talks were given to groups involved in community nutrition committees.

Bimonthly publication was continued of Nutrition Program News, which reaches some 6,000 workers in nutrition and related fields.

PUBLICATIONS - USDA AND COOPERATIVE PROGRAMS

Nutritional Evaluation of Dietary Carbohydrates

Bar-on, H., and Stein, Y. 1968. Effect of glucose and fructose administration on lipid metabolism in the rat. Jour. Nutr. 94:95.

Chang, M. L. W. 1968. Liver enzymes influenced by dietary carbohydrate and egg. Fed.Proc. 27: 258. (Abstract.)

Durand, A. M. A., Fisher, M., and Adams, M. 1968. The influence of type of dietary carbohydrate: Effect on histological findings in two strains of rats. Archives of Pathol. 85: 318.

Lakshmanan, F. L., Schuster, E. M., and Adams, M. 1967. Effect of dietary carbohydrate on the serum protein components of two strains of rats. Jour. Nutr. 93: 117.

Nutritive Value of Meals as Served

Murphy, E. W., Grossman, E., and Forziati, F. H. 1968. The nutritive content of Type A lunches. School Lunch Jour. 22(4): 11-18.

Food and Nutrition Guidelines for Consumers

Consumer and Food Economics Research Division. 1968. Calories and weight--The USDA pocket guide. Home and Garden Bul. 153. 75 pp.

Human Nutrition Research Division and Consumer and Food Economics Research Division. 1968. Family fare...Food management and recipes. Home and Garden Bul. 1. 79 pp. (Revision.)

Human Nutrition Research Division. 1968. Baking for people with food allergies. Home and Garden Bul. 147, 12 pp.

Human Nutrition Research Division. Fruits in family meals: A guide for consumers. Home and Garden Bul. 125, 30 pp.

Food Consumption and Dietary Levels--1965 Nationwide Survey

Consumer and Food Economics Research Division. 1968. Food consumption of households in the United States, Spring 1965. Household Food Consumption Survey 1965-66 Rpt. 1. 212 pp.

Consumer and Food Economics Research Division. 1968. Dietary Levels of households in the United States. A Preliminary Report. ARS 62-17, 34 pp.

Consumer and Food Economics Research Division and Human Nutrition Research Division. 1968. Nutritive quality of diets, USA. A Report to the Committee on Agriculture of the U. S. House of Representatives. 135 pp.

(Additional reports from the 1965 nationwide survey are listed in the Progress Report of the Consumer and Food Economics Research Division.)

Nutritive Value of National Food Supply

Friend, B. 1968. Nutrients in United States food supply--A review of trends, 1909-13 to 1965. Amer. Jour. Clin. Nutr. 20(8): 907-914.

Friend, B. 1967. Nutritional review. Nat. Food Sit., NFS-122, Outlook issue, pp. 30-35.

Nutrition Program Service

Consumer and Food Economics Research Division. 1968. Proceedings of nutrition education conference, Feb. 20-22, 1967. Misc. Pub. 1075. 57 pp.

Consumer and Food Economics Research Division. 1967-68. Six issues of Nutrition Program News.

III. MARKETING AND ECONOMICS RESEARCH

ECONOMICS OF MARKETING
Marketing Economics Division, ERS

Problem and Objectives

The market for sugar in the United States, as well as for much of the world is highly regulated. After about 145 years of congressional actions affecting the sugar industry, the first Sugar Act was passed in 1934 known as the Jones-Costigan Act. It has been amended several times but still carries the basic philosophy of the original act. It embodies three major objectives: (1) to assure adequate supplies of sugar to consumers at reasonable and stable prices; (2) to maintain a healthy domestic sugar industry; and (3) to promote international trade.

The Act provides six principal means for dealing with the sugar problem. These are:

1. The determination each year of the quantity of sugar needed, at prices reasonable to consumers and fair to producers.

2. The division of the U. S. sugar market among the domestic and foreign supplying areas by the use of quotas.

3. The allotment of these quotas among the various processors in each domestic area.

4. The adjustment of production in each domestic area to the established quotas.

5. The levying of a tax on the processing of sugarcane and sugarbeets, with most of the proceeds to be used to make payments to producers to compensate them for adjusting their production to marketing quotas and to augment their income.

6. The equitable division of sugar returns among beet and cane processors, growers, and farm workers.

In implementing the intent of the Sugar Act, the Secretary of Agriculture is required to determine, between October 1 and December 31, how much sugar will be needed by consumers in the continental United States during the next calendar year. He takes into consideration the amount of sugar used during the preceeding twelve months, the current sugar inventory, and prospective changes in population and demand conditions. Finally, he must estimate the next year's sugar price and index of prices paid by farmers in order to set a requirement figure that will not result in excessively high or low sugar prices.

The next step is dividing the required quantity among domestic and foreign producers. This allocation is made by statutory formula. The domestic quota is adjustable upward if the Secretary's estimate of requirements exceeds 10.4 million tons, and downward if requirements are less than 9.7 million tons. During the last few years the U. S. requirements in millions of tons has been as follows: 9.2 in 1965, 9.8 in 1966, 10.2 adjusted to 10.6 in 1967, and 10.4 announced in December 1967 for 1968. During 1968 a series of increases, beginning in May, raised the U. S. sugar requirements to 11 million tons. In December 1968 the requirements for 1969 of 10.6 million tons were announced. The allocation is roughly 3,000,000 tons to sugarbeet growers, and 1,000,000 tons each to (1) mainland sugarcane growers, (2) Hawaii, and (3) Puerto Rico. Some 4,000,000 tons would come from 31 foreign countries.

World sugar production for 1968-69 is estimated at 76 million short tons. This is a record crop--exceeding the previous high in 1967-68 by 4.5%.

In the United States annual per capita consumption averages about 97 lbs. When the sugar program became effective in 1934, the mainland cane and beet producers were supplying only 28% of the domestic market. Today the mainland produces more than 40% of our needs, with the off-shore domestic areas of Hawaii, and Puerto Rico supplying an additional 15% to 20%. The balance, almost all cane, is imported. The price of sugar to consumers in the U. S. is lower than the average for other countries that do not produce their own total sugar needs. The sugar program has assured the consumer of a constant and adequate supply of sugar. At the same time, the price of sugar has increased less than the price of all food in the U. S.

Progress - USDA and Cooperative Programs

The USDA has the equivalent of about two scientist man-years devoted to research on sugar marketing. The effort devoted by State Experiment Stations in the regional project discussed below varies from the part time of one scientist-man-year in some of the states to approximately full time in others.

1. Sugar Substitutes. Research on the current economic importance and growth potentials for various substitutes for sugar has continued and a chapter on "Sugar Substitutes" has been prepared as a part of a manuscript dealing with synthetics and other substitutes for agricultural products, which is now in process of publication. Among the newer developments cited are the manufacture of dihydrochalcones (intensely sweet substances prepared from citrus waste), the production of corn sirup containing sufficient levulose to substantially increase the sweetness of the product and the production of sugar from sorgo and the stalks of a variety of corn which produces few ears or kernels. Sugar obtained from new plant sources such as sorgo or corn is not a substitute but may have a somewhat similar effect on sugar beet and sugarcane growers, since, sugar from these plants would increase the competition from beets and cane.

2. Cooperation with Regional Research in Sugar Marketing at State Agricultural Experiment Stations. Work on a regional research project "Economic Factors Affecting Sugar Marketing" has continued at a number of State experiment stations. States actively cooperating in the project include Colorado, Utah, California, Hawaii, North Dakota, Minnesota, Montana, Michigan, and Puerto Rico. The general purposes of the overall study are:

1. To project future domestic and world demand for sugar.

2. To assess the capacity of domestic and foreign sugar industries to respond to changes in demand.

3. To study structural and performance characteristics of the sugar industry.

4. To appraise implications of the various demand, supply, and structural relationships on the development of the domestic sugar industry and on U. S. sugar trade.

Individual studies under this project already published include:

1. Changes in Sugar Beet Production in Colorado, Colorado State Agricultural Experiment Station, Bulletin 530-S, January 1968.

2. Consumer Images of Sugar and Synthetic Sweeteners, Michigan Agricultural Experiment Station, Research Bulletin 18, 1968.

Also, the University of California reports that three manuscript dealing with various aspects of the study have been prepared, another is nearing completion, and still another is projected. It is expected that these will finally be combined into a single publication.

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